PEANUT MOISTURE METER STUDY

1962-1963

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SUMMARY

A statistical evaluation of three different models of electronic meters for measuring moisture of peanuts indicates that the only major difference which exists among the meters is the range of moisture each meter can reliably predict.

Detailed explanation is given in this report of the method used in developing the multiple regression equations for converting meter readings to percent moisture as well as the procedures for determining the precision of the meters. Additional information is presented on the procedures for conducting the meter and 4-hour oven test.

REASONS FOR MAKING STUDY

There are several reasons for making a study of this kind. First, there are several new or improved electronic moisture meters that have been introduced within the last few years. It is important to learn the degree of accuracy of these instruments. Second, the importance of accurately converting meter readings to percent moisture has increased. The development of mechanical sampling equipment which enables a larger and more representative sample of peanuts to be drawn from each load has increased the proportion of sampling error due to converting meter readings to moisture. Third, the demand has increased for moisture meters which can reliably predict moistures greater than 14 percent.

OBJECTIVES OF STUDY

The major objective of this study was to obtain multiple regression equations for converting moisture meter readings to percent moisture. Equations were developed for the Burrows, Steinlite 500 PT, and Motomco moisture meters for use with Runner, Spanish, and Virginia type peanuts.

An additional objective of this study was to obtain information on the precision of one moisture meter to determine how well it compared with the precision obtained previously on other moisture meters.

The final objective was to evaluate statistically the relative merits of the meters with respect to their accuracy and precision, and the range of moisture each meter could reliably predict using a comparison with the results from a 4-hour drying period in a forced air oven as the standard.

A small number of samples also was obtained for studying the Steinlite PT-2 moisture meter. The results of this study will be reported at a later date after additional data have been collected and evaluated.

COLLECTION AND PREPARATION OF FARMERS' STOCK PEANUTS

Samples of farmers' stock peanuts were obtained at inspection points in Georgia for the meter and oven drying tests. Sixty samples were obtained for each type of peanut tested. The types of peanuts included in the tests were Runner, Spanish, and Virginia.

Samples of each type peanut were grouped into sets of 10 samples. The moisture composition of the sets for each type of peanut is as follows:

Composition of Sets for Each Type Peanut

Set Number	Approximate Percent Moisture*					Set Total
	4-5	6-8	9-12	13-16	over 16	
1	2	2	2	2	2	10
2	2	2	2	2	2	10
3	2	2	2	2	2	10
4	2	2	2	2	2	10
5	2	2	2	2	2	10
6	2	2	2	2	2	10
Total	12	12	12	12	12	60

*Obtained from Inspection Certificates.

Each set was to be analyzed on a given day at selected temperature levels. Every effort was made to closely approximate the requested moisture distribution in each set. This precaution was taken so that all the samples of a given moisture level would not be analyzed on one day and at a restricted range of temperature.

After shelling, the samples were bagged individually as follows:

1. Each sample was weighed to verify that it contained at least 400 grams of shelled peanuts.
2. Each sample was immediately placed in a plastic bag to prevent moisture change. The top each bag was folded down and securely taped shut with a wide band of masking tape.
3. Next, each sample was labeled with its type, approximate moisture, set number, and location of the place of analysis.
4. A check sheet was maintained to keep track of the number and moisture compositions of the samples as they were prepared. After the required sets for each type of peanut and location had been accumulated, they were taken to the State Experiment Station at Tifton, Georgia, for analysis.

The requested number of samples was collected as planned. However, it was difficult to obtain the desired moisture level in some sets. Initially several sets contained samples that were artificially prepared to approximate the desired moisture composition. These samples were later omitted from the analysis because they were unnatural samples due to the method of preparation. We do not recommend using artificially prepared samples in the moisture tests for several reasons. First, this type sample is not found in actual practice. Secondly, the meter readings for the samples are usually quite variable and do not give an accurate estimate of the moisture in the sample.

MOISTURE METER AND OVEN TESTS

The meter and oven tests were conducted at the Georgia Coastal Plains Experiment Station, Tifton, Georgia. The station extended to us the use of laboratory facilities including storage space and a forced air drying oven for the required 4-hour oven tests. Technical advice and assistance in planning and conducting the meter and oven tests were given by W. Haward Hunt, Grain Division, Agricultural Marketing Service.

Preparation of Equipment for Tests

Immediately upon receipt of the sets of samples, they were stored in a refrigerated location until the time of testing.

The following preparations were made prior to the first day of testing:

1. The 20 drying pans were oven dried for one hour at 130° C. They were then cooled in a desiccator and weighed accurately to three decimals.

2. The 10 pint cans were assembled, some with plastic caps, and several with rubber stoppers containing laboratory thermometers.
3. The three moisture meters were checked to assure that they were in proper working order prior to time of testing.

Schedule of Analysis

On the day prior to the start of the meter and oven tests, the set of samples indicated for sampling was set out and allowed to stabilize overnight at room temperature.

The schedule of analysis used in these tests was as follows:

Schedule of Analysis for Each Set of Samples

Day	Sample Set No.	First Readings: Temp. of 70°-80°		Second Readings: Temp. of 55°-65°		Second Readings: Temp. of 85°-95°	
		Number of Sub-samples	Order of Testing*	Number of Sub-samples	Order of Testing**	Number of Sub-samples	Order of Testing**
1	1	10	ABC***	Same 10	BAC	------	----
2	2	10	BAC	------	----	Same 10	CBA
3	3	10	ABC	Same 10	ACB	------	----
4	4	10	BAC	------	----	Same 10	BAC
5	5	10	ABC	Same 10	CBA	------	----
6	6	10	BAC	------	----	Same 10	ACB

*Test each sub-sample in all 3 meters before proceeding to next sub-sample.
**Test all 10 sub-samples in one meter before proceeding to next meter.
***A, B, and C: Letter designations of different brand moisture meters.

Preparation of Samples for Tests

The following procedures were followed to prepare each set of samples for meter and oven tests the day they were tested:

1. Each sample was shaken thoroughly to mix the contents in preparation for drawing an oven and meter sub-sample.
2. The first sample was poured from the plastic bag to a screen. Here, the rotten peanuts and foreign material were removed.
3. An oven sub-sample of approximately 50 grams was then selected and placed in the first of the consecutively numbered drying pans. The lid was immediately placed on the drying pan and the number recorded on the data sheet. The oven sub-sample was then set aside for exact weighing at a later time.
4. A 250 gram meter sub-sample was selected and weighed from the remaining portion of the first sample. This meter sub-sample was quickly sealed in one of the pint grain cans with a plastic cap or laboratory thermometer. Next, the can number of this sub-sample was recorded on the data sheet.
5. The remaining portion of the original 400 gram sample was returned to the plastic bag and sealed. This was to be retained in the event that peanuts were inadvertently lost from the 50 and 250 gram sub-samples during the tests which followed.
6. Finally, the 250 gram meter sub-sample was set out and allowed to stabilize with the room temperature.

After all 10 meter sub-samples had been prepared for testing as indicated above, the 10 oven sub-samples in the numbered drying pans were weighed to three decimals and recorded.

Meter Tests

The next procedure was to obtain meter readings from the set of 250 gram meter sub-samples which were at room temperature. A single meter reading on each sub-sample was to be obtained

for two of the meters, while duplicate meter readings were to be obtained for the third meter. This procedure enabled us to check the precision of one of the meters and collect information for the regression analysis at the same time.

Generally, it is desirable to obtain duplicate meter readings from each sub-sample for all of the meters in the test. This was not done for two reasons. First, repeated handling of the sub-samples could possibly cause the moisture of the sample to change significantly from the corresponding 50 gram oven sub-sample. Secondly, two of the meters had been checked for precision previously and no additional data was needed.

The following procedure was used for all sets of sub-samples:

1. The schedule of analysis was consulted to determine the order in which each sub-sample was to be tested in the meters.
2. Next, the temperature of the first sub-sample was read from the laboratory thermometer and recorded. The thermometer was then transferred to a sub-sample in a pint can previously covered by a plastic cap.
3. The meter sub-sample was immediately transferred from the pint grain can to the test cell of the meter designated to be used first. A meter reading was obtained, and the sub-sample removed from the test cell of the meter. The meter reading was then recorded on the data sheet.
4. The meter sub-sample was next transferred to the test cell of the meter designated to be used second. A meter reading was obtained, and the sub-sample removed from the test cell of the meter. The meter reading was then recorded on the data sheet.
5. The sub-sample was next transferred to the test cell of the meter designated to be used last. A meter reading was obtained, and the sub-sample removed from the test cell of the meter. The meter reading was then recorded, and the sub-sample returned to the test cell of the same meter. The second meter reading was obtained and recorded. The sub-sample was then removed from the test cell of the meter, returned to the pint grain can, and the plastic cap placed on the can.
6. Finally, the sub-sample was placed in a temperature chamber in the temperature range indicated on the schedule of analysis.

The above procedures were repeated for each of the remaining meter sub-samples.

An additional meter reading was then obtained for each meter from each sub-sample at a new temperature. The procedure was as follows:

1. The schedule of analysis was consulted to determine which meter to use first in the retesting of the sub-samples. In these tests, all sub-samples were tested in a single meter and returned to the temperature chamber before proceeding with the next meter. In addition, no sub-samples were tested until they had sufficient time to stabilize at the desired temperature.
2. The first sub-sample was removed from the temperature chamber and the temperature was recorded. A single meter reading was obtained using the designated meter. This meter reading was recorded, and the sub-sample was resealed in the pint can and returned to the temperature chamber. This procedure was repeated for each of the remaining 9 sub-samples in the set, using the same meter.
3. Next, each of the ten sub-samples was tested in the meter designated to be used second. Temperature and meter readings were recorded and the sub-samples returned to the temperature chamber as was done for the preceding meter.
4. Finally, the sub-samples were tested in the meter designated to be used last.
5. Immediately after the temperature and meter readings were obtained and recorded, a 50 gram oven sub-sample was obtained from the meter sub-sample and placed in one of the remaining drying pans and covered. The pan number and weight to three decimals was then recorded on the data sheet.

The 50 gram oven sub-sample obtained from each meter sub-sample at the end of meter testing was used to determine if the moisture in the sub-sample had changed due to handling. This determination could be made by comparing the moisture loss of the oven sub-sample obtained prior

to the meter tests with the moisture loss of the oven sub-sample obtained from the meter sub-sample. If a large difference was found, we assumed that the moisture of the sub-sample changed during the meter tests. Some sub-samples, predominantly those over 14 percent moisture, differed in this manner and were omitted from the analysis because an accurate moisture determination was impossible. This procedure for determining moisture changes in the sub-sample is recommended for tests which necessitate a large amount of handling.

Oven Tests

The following procedures were used in conducting the oven tests:

1. The oven was preheated to 130° C.
2. All 20 weighed drying pans were placed in the oven with the corresponding covers underneath each pan. The pans were positioned in the oven so that the thermometer bulb was slightly higher than the drying pans.
3. When the oven temperature returned to 128° C, the four-hour timing period was started.
4. At the end of the four-hour timing period, the drying pans were removed from the oven. The lids were quickly replaced on the pans and the pans transferred to the desiccator to cool.
5. After the pans had cooled, they were removed one at a time and weighed to three decimals. The results were recorded on the record sheet next to the original weights of the pan.

From the oven tests, information was obtained on the net weight of the oven sub-sample before and after drying. The difference between the two net weights is the weight loss due to drying. The percent moisture in the sub-sample was obtained by dividing the net weight of the sub-sample before drying into the weight loss and multiplying this quotient by 100.

DEVELOPMENT OF MULTIPLE REGRESSION EQUATIONS

After all sets of peanuts were tested in the three meters and the oven, the data was sent to the Washington office for analysis. The following steps were taken in the process of preparing the data for further analysis:

1. A scatter plot was prepared by plotting each meter reading versus the temperature of the sub-sample and labeling the point with the percent oven moisture of the sub-sample. Figures 1 through 9 contain the scatter plots for each meter and peanut type combination. Note that the meter readings have been coded and do not represent the exact meter readings obtained.
2. Next, the scatter plots were examined for sample results that appeared to be in error. The computations and plotting were checked on all such points and a determination was made on whether or not to include the data in further analyses. For example, many of the artificially prepared samples were out of line when plotted on the charts. Therefore, all artificially prepared samples were eliminated from the analysis to prevent a possible distortion of the results.
3. Finally, the data were key-punched and verified in preparation for the regression analysis.

The regression equations that were developed were obtained by using the computer and computer program available in the Department. The meter reading was designated as the dependent variable and the significance of the following independent variables was tested:

1. Temperature
2. Percent oven moisture
3. Percent oven moisture squared
4. Percent oven moisture cubed
5. Percent oven moisture times temperature
6. Percent oven moisture squared times temperature
7. Percent oven moisture cubed times temperature.

Independent variables 5, 6, and 7 allow for the possibility of a joint relationship of percent oven moisture and temperature. The results of the analysis indicated that a significant joint relationship was present for all meters and types of peanuts tested. This emphasizes the importance of taking this relationship into account when the moisture meter charts are constructed. The

following tabulation lists the significant variables and other pertinent data relating to the multiple regression analysis:

Summary of Results of Regression Analysis

Meter	Peanut	Significant Indep. Variables*							Sample Size (n)	R^2**	s***	Range of Equation (% H_2O)
		T	O	O^2	O^3	OT	O^2T	O^3T				
A	Runner			X			X	X	99	.9958	.24	4.0 to 15.5
A	Spanish		X		X	X		X	96	.9978	.19	4.0 to 17.0
A	Virginia			X		X	X	X	106	.9972	.22	4.0 to 17.0
B	Runner			X		X	X		101	.9976	.19	4.0 to 14.5
B	Spanish		X					X	89	.9966	.18	4.0 to 14.5
B	Virginia			X		X	X		107	.9958	.23	4.0 to 14.5
C	Runner		X				X		114	.9964	.30	4.0 to 18.5
C	Spanish	X	X	X				X	100	.9984	.18	4.0 to 18.5
C	Virginia		X			X	X		112	.9982	.18	4.0 to 18.5

*In each equation the meter reading is the dependent variable and an X indicates a significant independent variable. Explanation of abbreviations in table: T = Temperature of sample; O = Percent oven moisture in sample; O^2 = Percent oven moisture squared; O^3 = Percent oven moisture cubed; OT, O^2T, O^3T = combinations of temperature and percent oven moisture.

**Coefficient of determination.

***Standard error of estimate converted to percent oven moisture to allow a comparison among meters.

The sample sizes listed above are the number of observations used in the equation whose significant variables are checked. More observations were available for some of the regressions but were not used because of their questionable validity. The coefficients of multiple determination show the proportion of the variability in meter readings that can be explained by the significant independent variables. It is noted that they are very close to unity, which leaves very little room for improvement of the equation for the indicated range of the data. The standard error of estimate for each equation was converted to percent oven moisture so that a comparison can be made of the relative error for each meter. The standard errors indicate that there is little difference in the relative accuracy of the meters, provided the suggested equations are used.

Before the final equations were approved for use in constructing the moisture conversion charts, moisture lines for selected percent oven moistures were obtained from the equations and drawn on the scatter plots. Examples of these moisture lines can be seen in Figures 1 through 9. The charts were then examined to see how close a fit was obtained between the actual and predicted percent oven moistures.

On some of the scatter plots, the moisture lines did not lie very close to the points of the same moisture. This poor fit usually occurred in the upper portion of the scatter plot where the high moisture samples are plotted. When this happened, all samples above a selected moisture were eliminated and another regression equation was obtained with the smaller number of points. This procedure restricted the range of usefulness of the chart but improved the chart in the range of data used in the equation. The data above a certain moisture level was not eliminated in other equations of the same type peanut but only in the equation where a poor fit was obtained. As indicated in the preceding table, some equations for a given type of peanut are valid in the higher moisture range while others are not. This is principally due to the different ability of the meters since the same samples were used to develop the equations for each meter.

Charts for Converting Meter Readings to Percent Moisture

The suggested form of the multiple regression equations is not adaptable to the present form of the meter reading conversion charts currently being used with the moisture meters. An example of the type of conversion chart currently being used is shown in Figure 10. The figures in the chart are fictitious and are only for illustrative purposes. To use this chart, one must add or subtract the temperature correction factor to the percent moisture which corresponds to the meter reading of the sample.

An alternate form for the conversion charts has been proposed to handle the suggested multiple regression equations. This chart shown in Figure 11, is similar to the scatter plots with the moisture lines. The only difference is that the proposed chart has moisture lines for fractions of a moisture throughout the range of the chart. To use this chart, find the meter reading and temperature of the sample along the left and bottom margins, respectively. The nearest moisture line to the point where the meter reading and temperature line intersect is the percent moisture of the sample.

The new form of conversion chart that is suggested is easier and faster to use than the current charts and will result in fewer errors when converting meter readings to percent moisture.

PRECISION OF METERS

The precision of each meter was evaluated by determining the variability of duplicate meter readings using a number of samples of Runner, Spanish, and Virginia type peanuts. As explained earlier, Meter C was checked for precision in this series of tests and Meters A and B were checked in a previous season. The number of samples in the tests were 60 for one of the meters and 123 to 166 for the other meters depending on the type peanut. Sample sizes have been omitted to prevent disclosure of the identity of the meters. The following tabulation lists the results of these tests.

Summary of Precision Tests

Meter	Type of Peanut	Sampling Error *
A	Runner	.0963
	Spanish	.0685
	Virginia	.144
B	Runner	.0835
	Spanish	.0890
	Virginia	.0950
C	Runner	.135
	Spanish	.207
	Virginia	.189

*Sampling errors were converted to percent oven moisture for comparative purposes.

The sampling errors in the above tabulation are a measure of how well any two meter readings (or repeated meter readings) of the same sample agree. The sampling errors are given in units of percent moisture rather than meter readings. The smaller the sampling error the greater the precision of the meter and the smaller the disagreement of repeated readings.

An evaluation of the precision of the meters indicates that the precision is less for Meter C than either of the other two meters.

The sampling errors in the above tabulation give guidance on the difference that could be found between two meter readings of the same sample. We can also give guidance on the difference a single meter reading could vary from the true meter reading of the sample. A single meter reading of a sample should not differ from the true meter reading of the sample by more than 2 times the sampling error. For example, a meter reading of Runner peanuts in Meter A, should

not differ by more than 0.19 percentage points of moisture from the true meter reading of the sample when both are converted to percent moisture. This difference would amount to 0.17 percentage points for Meter B and 0.27 percentage points for Meter C. Similar results are found for comparisons of the other two types of peanuts.

STATISTICAL EVALUATION OF METERS

The statistical evaluation of the meters consisted of judging the relative merit of each meter on several factors. These factors were:

1. Precision of the meters (variability of repeated meter readings).
2. Accuracy of the meters in converting meter reading to percent moisture.
3. Range of moisture that each meter can reliably predict.

The total variability of the estimate of percent moisture for each meter is determined by combining estimates of precision and accuracy.

The conclusion is that the only major difference which exists among the meters is the range of moisture each meter can reliably predict. The data on precision indicate that Meter C has less precision than either of the other two meters. The data obtained on the accuracy of the meters indicate that there is slight difference in accuracy of the meters when the suggested regression equations are used. When the total variability is determined for each meter we find that little practical difference exists.

The range of moisture that these meters can reliably predict differs for each meter as indicated in the tabulation summarizing the results of the regression analysis. Meter C can predict moisture in the range of 4.5 to 18.5 percent moisture for each of the types of peanuts studied. Meter A can predict moisture in the range of 4.5 to 17.0 percent moisture for Spanish and Virginia type peanuts and the range of 4.5 to 15.5 percent moisture for Runner type peanuts. Meter B can predict moisture in the range of 4.5 to 14.5 percent moisture for all three types of peanuts.

Improvements should be made on all of the meters. Specifically, they should be improved with respect to the upper limit of the range in which moisture can be predicted, while Meter C also could be improved with respect to its precision.

Other non-statistical factors such as cost, durability, and ease of operation must also be considered in selecting a meter. We recommend that the non-statistical factors as well as the statistical factors be considered in obtaining a total evaluation of each meter.

FIGURE 1.-- SCATTER PLOTS OF SAMPLES OF FARMERS STOCK PEANUTS, COMPANY A, RUNNER TYPE PEANUTS.

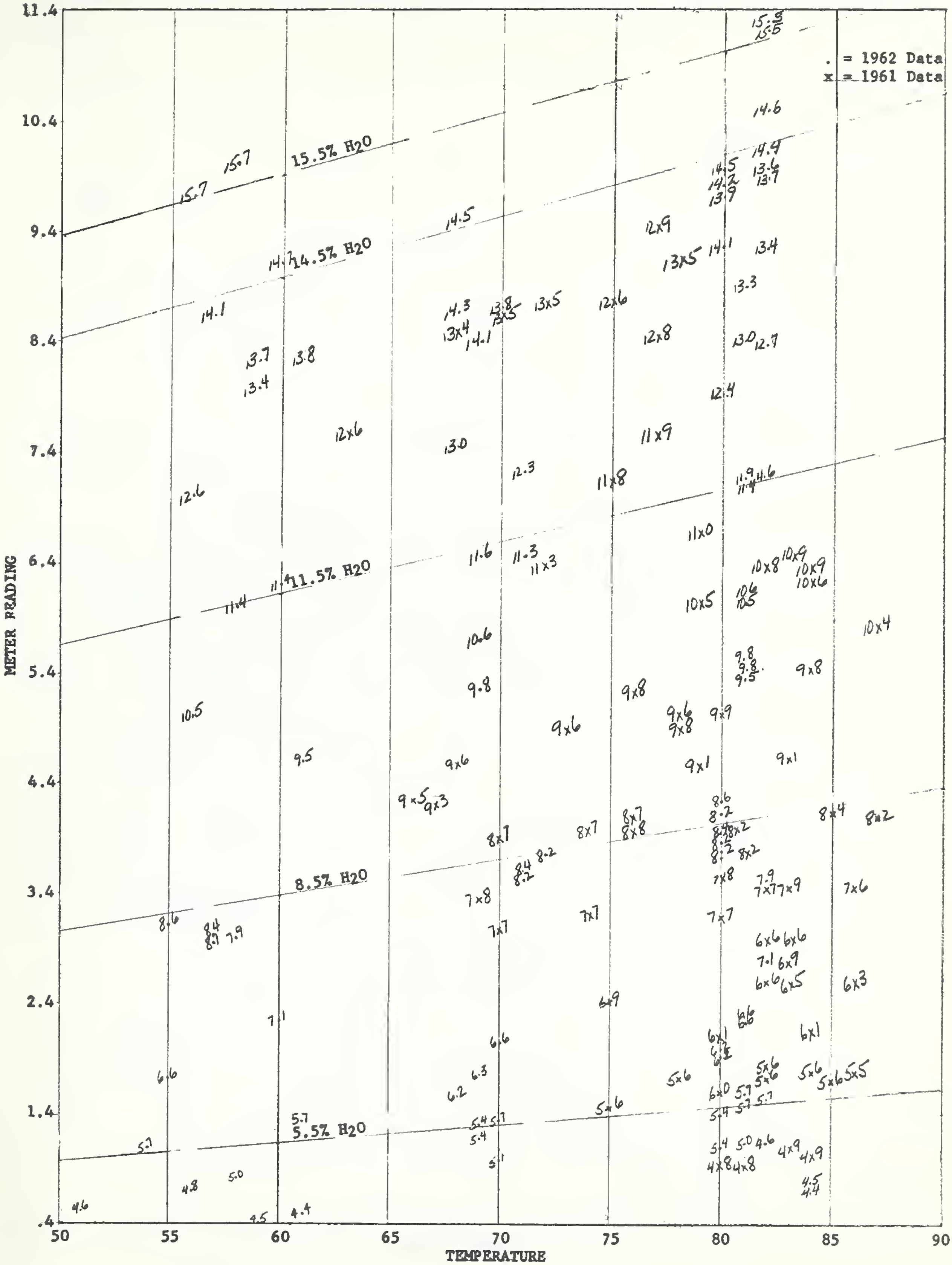

Figure 1

FIGURE 2.-- SCATTER PLOTS OF SAMPLES OF FARMERS STOCK PEANUTS, COMPANY A, SPANISH TYPE PEANUTS.

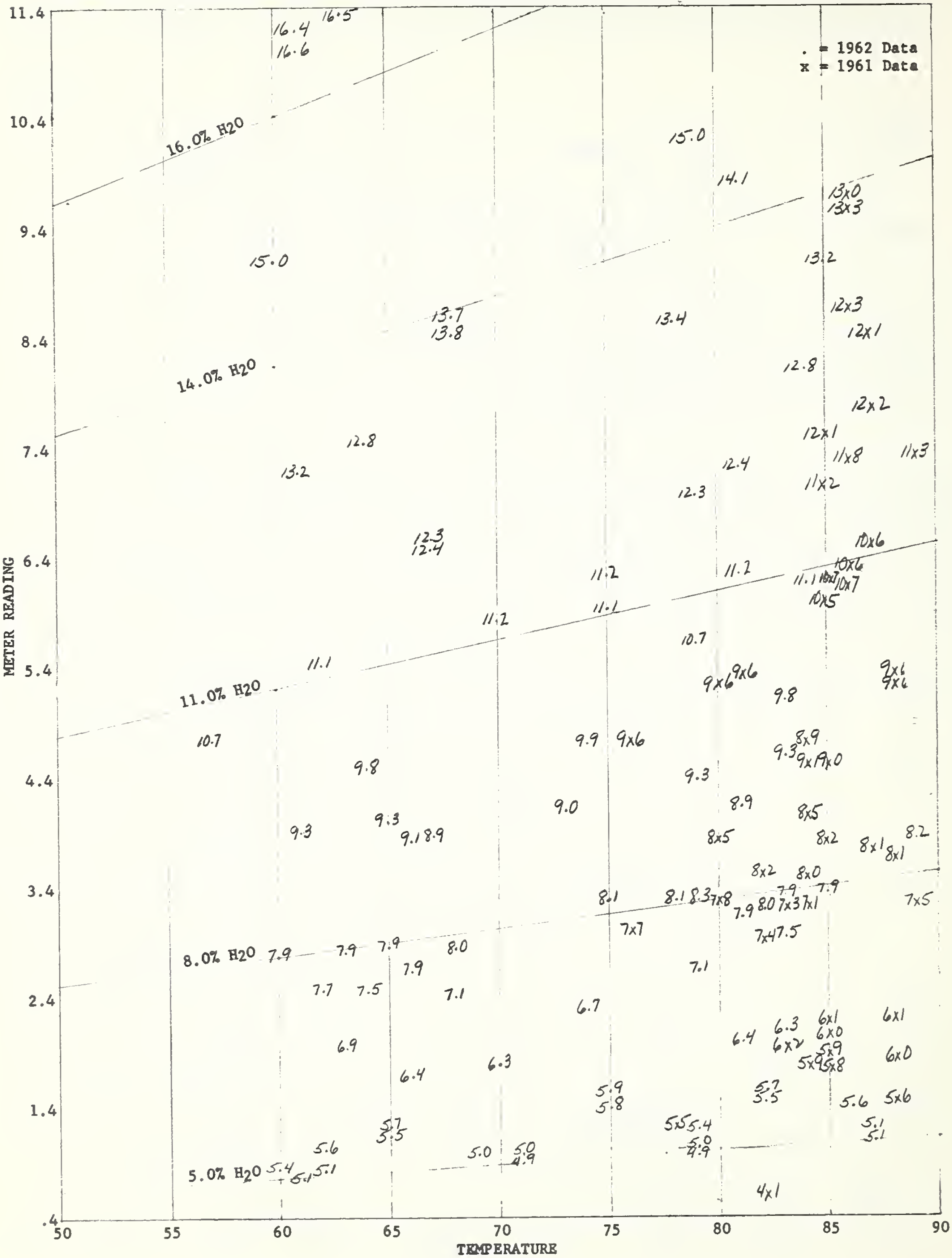

Figure 2

FIGURE 3.-- SCATTER PLOTS OF SAMPLES OF FARMERS STOCK PEANUTS, COMPANY A, VIRGINIA TYPE PEANUTS.

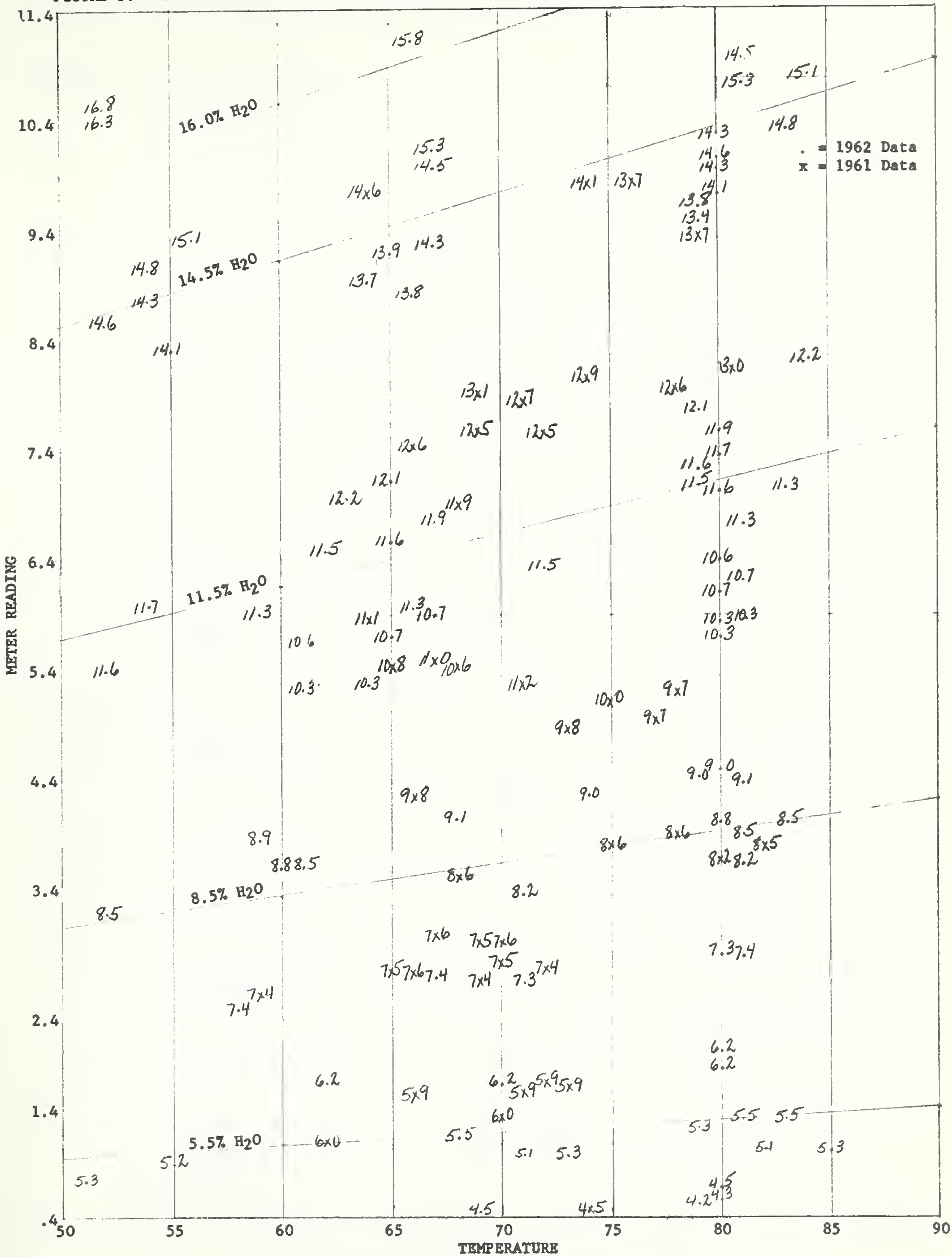
METER READING
TEMPERATURE
16.0% H2O
14.5% H2O
11.5% H2O
8.5% H2O
5.5% H2O
. = 1962 Data
x = 1961 Data
11.4
10.4
9.4
8.4
7.4
6.4
5.4
4.4
3.4
2.4
1.4
.4
50
55
60
65
70
75
80
85
90

Figure 3

FIGURE 4.-- SCATTER PLOTS OF SAMPLES OF FARMERS STOCK PEANUTS, COMPANY B, RUNNER TYPE PEANUTS.

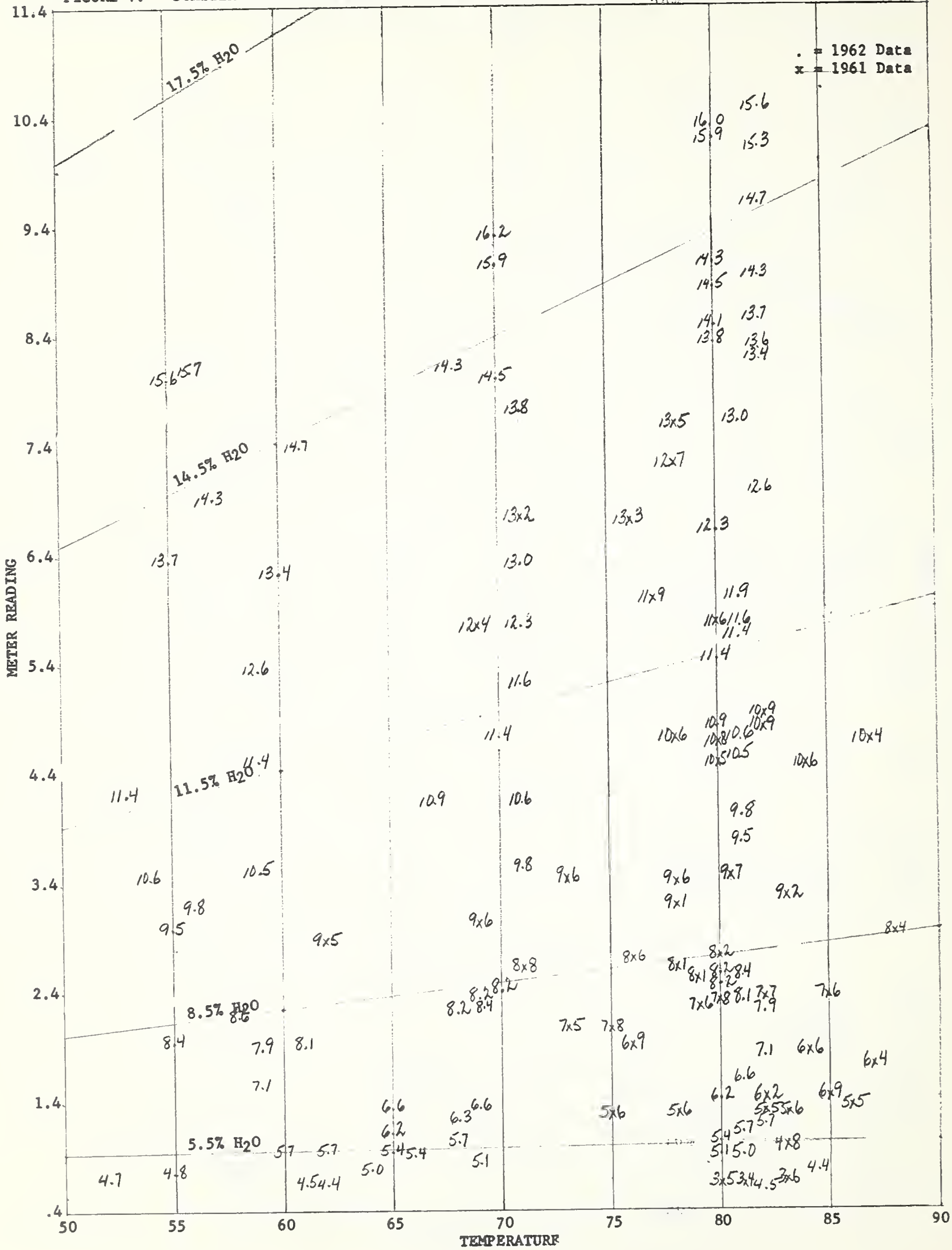

Figure 4

FIGURE 5.-- SCATTER PLOTS OF SAMPLES OF FARMERS STOCK PEANUTS, COMPANY B, SPANISH TYPE PEANUTS.

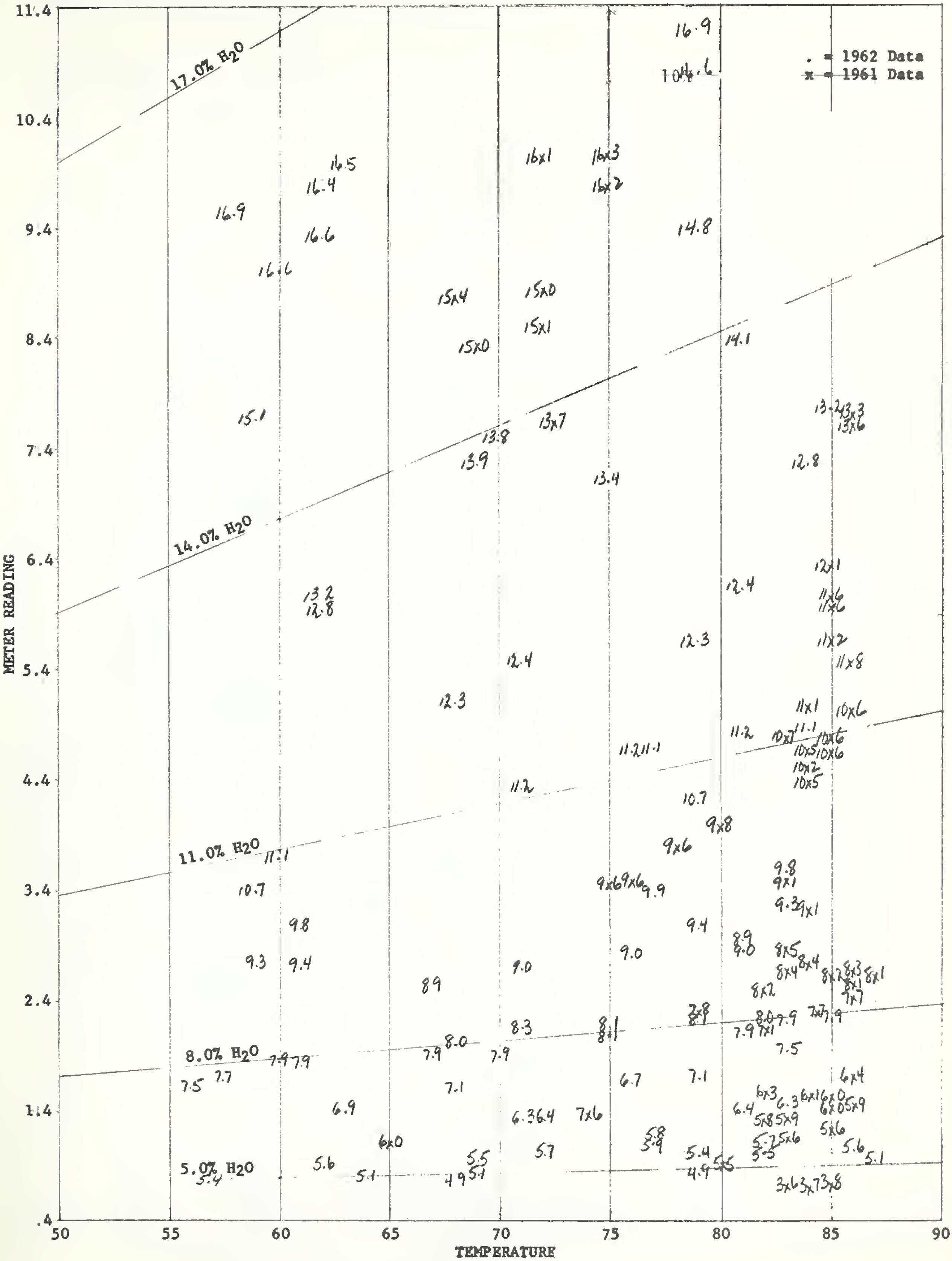

Figure 5

FIGURE 6.-- SCATTER PLOTS OF SAMPLES OF FARMERS STOCK PEANUTS, COMPANY B, VIRGINIA TYPE PEANUTS.

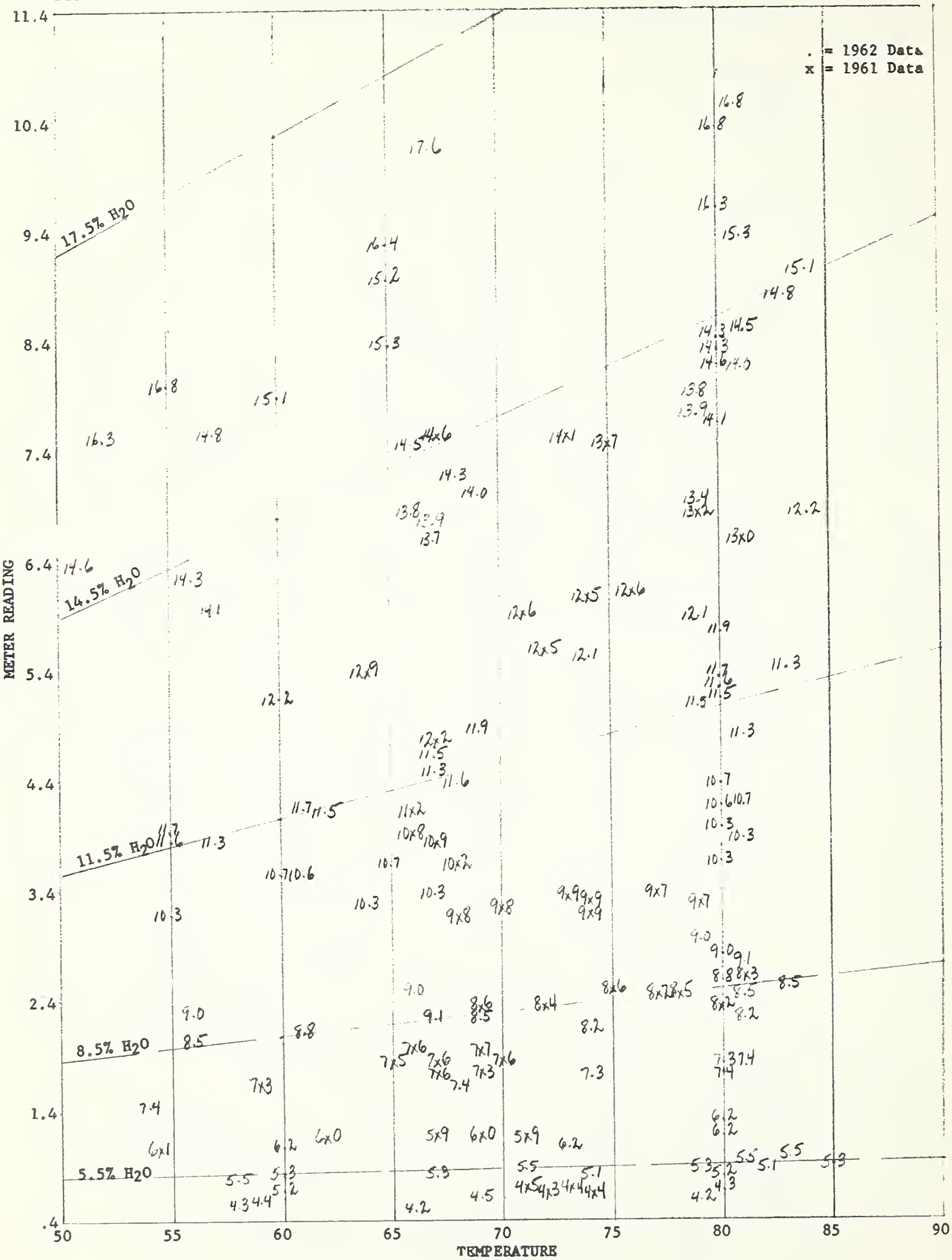

Figure 6

FIGURE 7.-- SCATTER PLOTS OF SAMPLES OF FARMERS STOCK PEANUTS, COMPANY C, RUNNER TYPE PEANUTS.

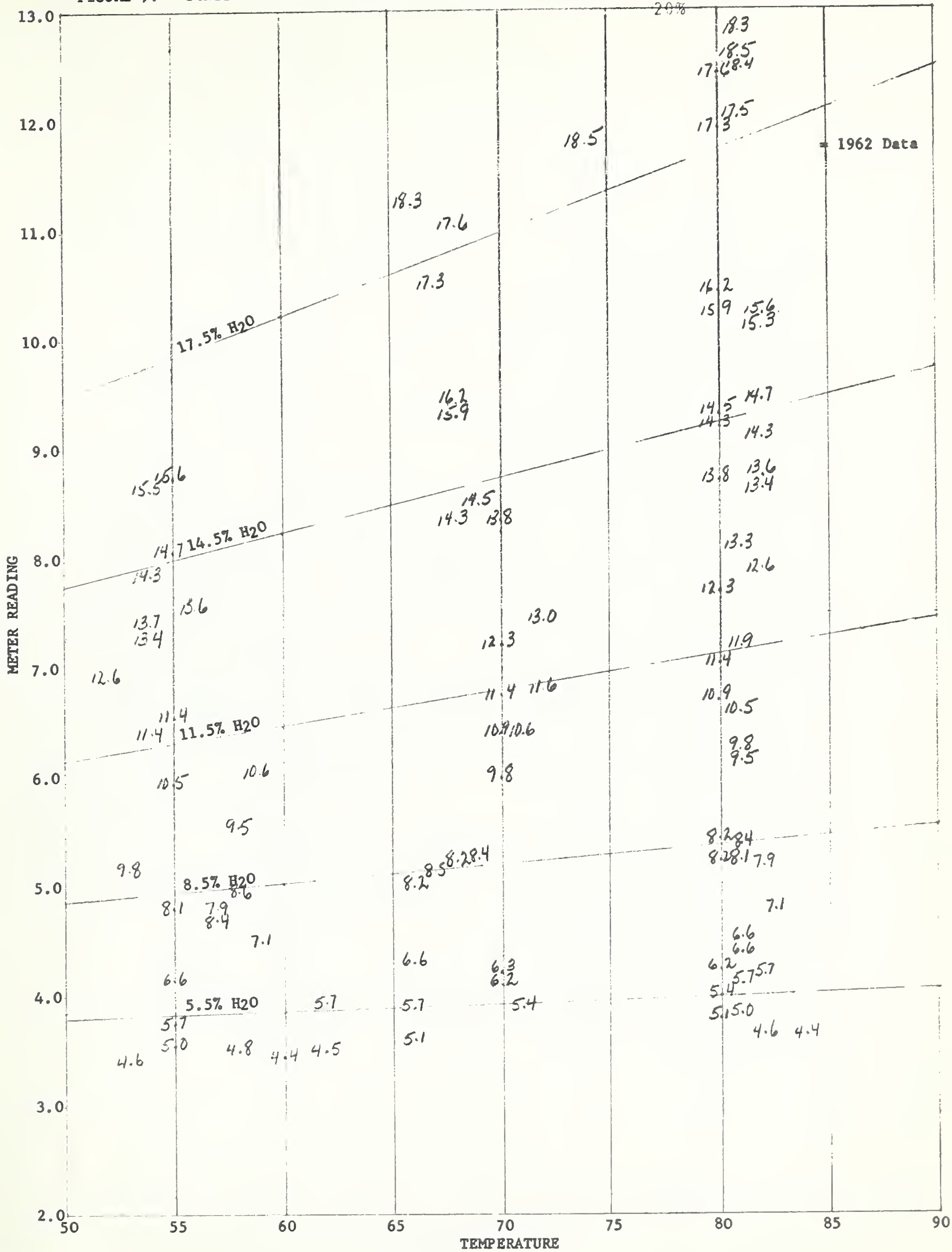

Figure 7

FIGURE 8.-- SCATTER PLOTS OF SAMPLES OF FARMERS STOCK PEANUTS, COMPANY C, SPANISH TYPE PEANUTS.

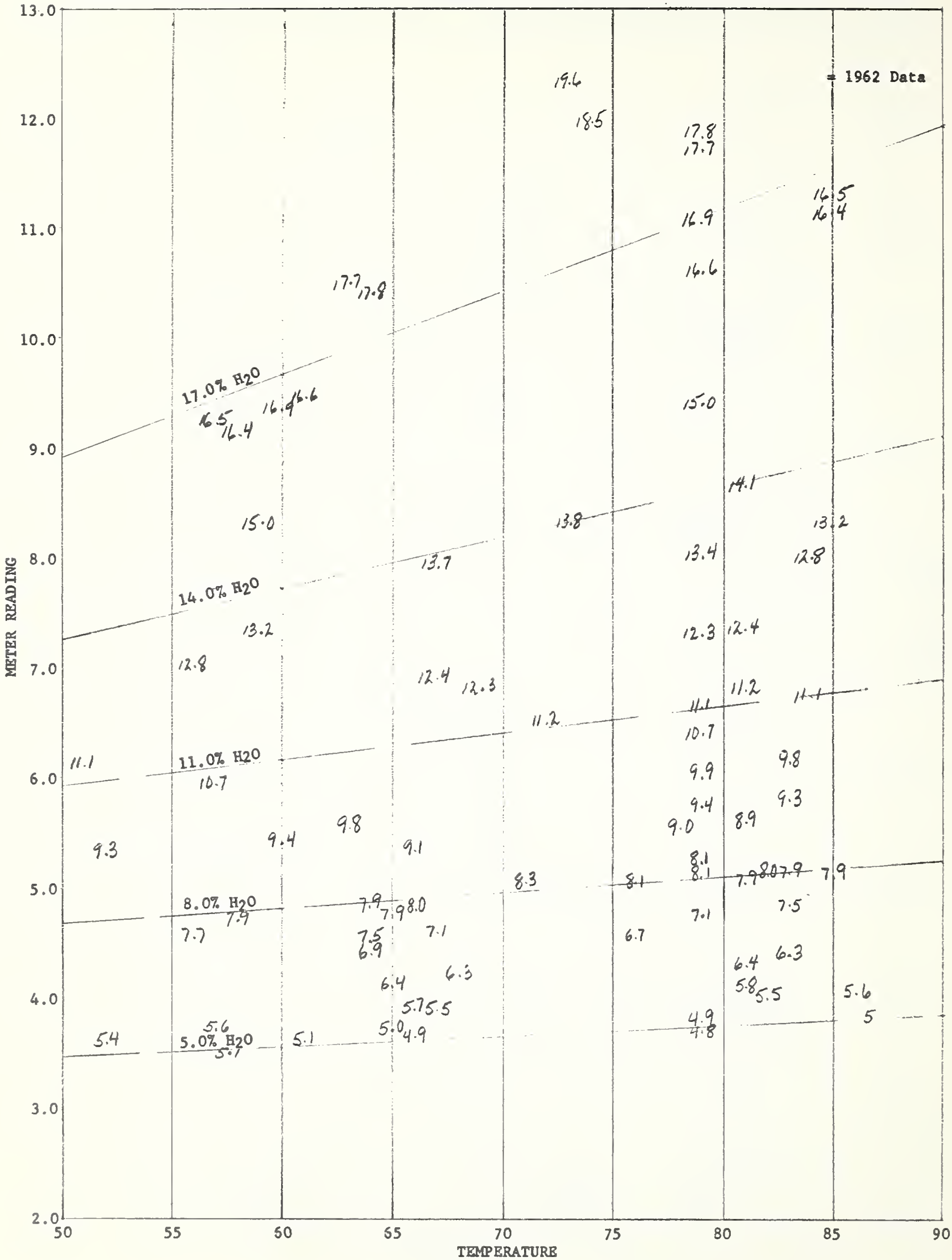

Figure 8

FIGURE 9.-- SCATTER PLOTS OF SAMPLES OF FARMERS STOCK PEANUTS, COMPANY C, VIRGINIA TYPE PEANUTS.

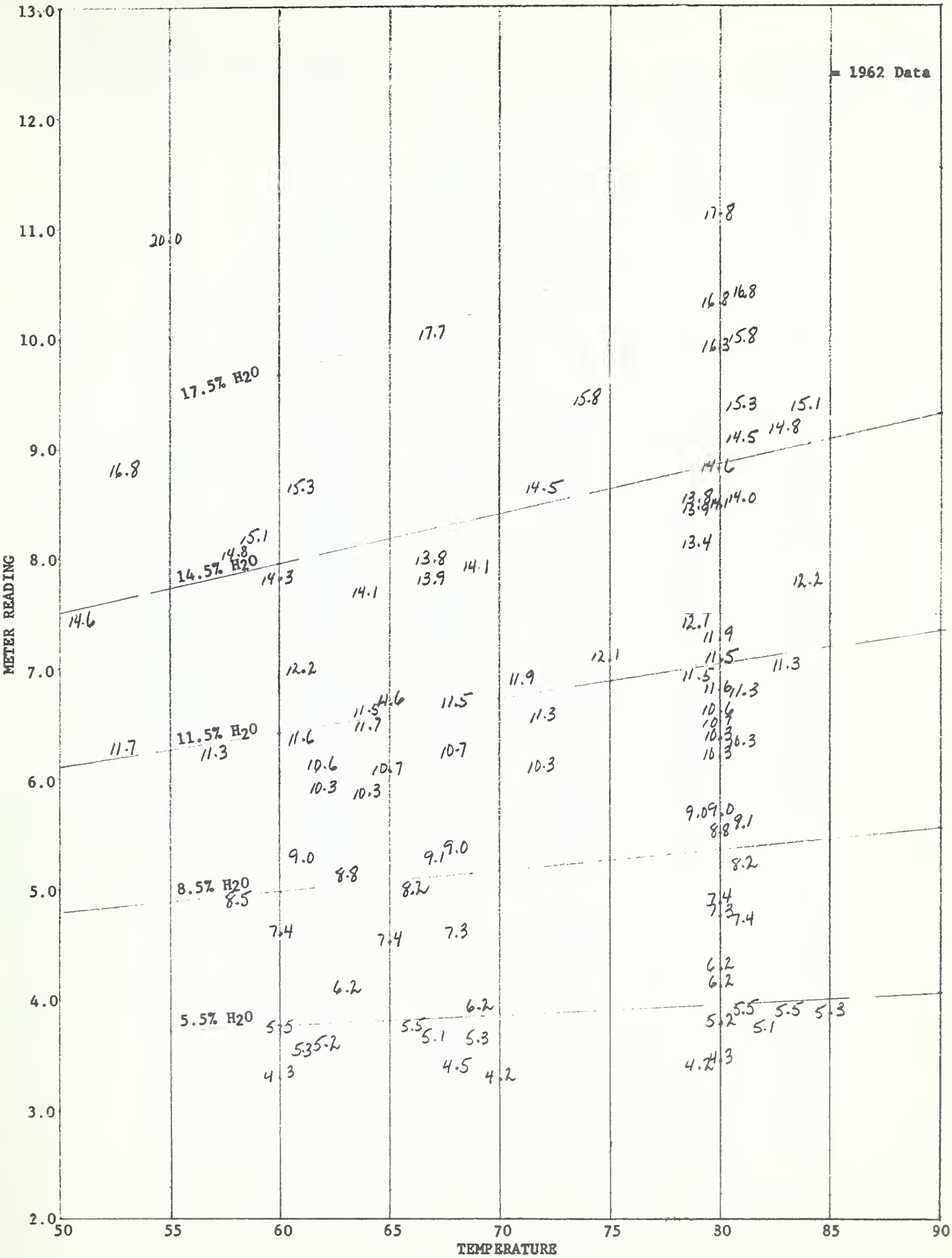

Figure 9

FIGURE 10.-- EXAMPLE OF CURRENT MOISTURE METER CHART

Company X — Sample Weight = 250 grams
Runner Type Peanut — Calibration Method: 4 Hrs. 130°C Forced Draft Oven

Meter Reading	Percent Moisture	Meter Reading	Percent Moisture	Meter Reading	Percent Moisture	Temperature Correction °F		Corr.
1	3.10	41	8.84	81	11.65	55	ADD	1.25
2	3.30	42	8.92	82	11.71	56	"	1.20
3	3.50	43	9.00	83	11.77	57	"	1.15
4	3.70	44	9.09	84	11.83	58	"	1.10
5	3.90	45	9.17	85	11.90	59	"	1.05
6	4.11	46	9.25	86	11.96	60	"	1.00
7	4.31	47	9.35	87	12.02	61	"	0.95
8	4.48	48	9.43	88	12.08	62	"	0.90
9	4.66	49	9.49	89	12.14	63	"	0.85
10	4.84	50	9.58	90	12.20	64	"	0.80
						65	"	0.75
11	5.02	51	9.66	91	12.26	66	"	0.70
12	5.24	52	9.75	92	12.32	67	"	0.65
13	5.42	53	9.83	93	12.38	68	"	0.60
14	5.60	54	9.91	94	12.44	69	"	0.55
15	5.78	55	9.98	95	12.50	70	"	0.50
16	5.96	56	10.05	96	12.56	71	"	0.45
17	6.14	57	10.13	97	12.62	72	"	0.40
18	6.32	58	10.21	98	12.69	73	"	0.35
19	6.50	59	10.29	99	12.74	74	"	0.30
20	6.65	60	10.37	100	12.80	75	"	0.25
						76	"	0.20
21	6.80	61	10.45	101	12.86	77	"	0.15
22	6.92	62	10.52	102	12.92	78	"	0.10
23	7.04	63	10.57	103	12.98	79	"	0.05
24	7.16	64	10.63	104	13.04	80	"	0.00
25	7.28	65	10.69	105	13.10			
26	7.40	66	10.75	106	13.16	81	SUB	0.05
27	7.50	67	10.82	107	13.22	82	"	0.10
28	7.60	68	10.87	108	13.28	83	"	0.15
29	7.70	69	10.93	109	13.34	84	"	0.20
30	7.81	70	10.99	110	13.40	85	"	0.25
						86	"	0.30
31	7.91	71	11.05	111	13.46	87	"	0.35
32	8.01	72	11.12	112	13.53	88	"	0.40
33	8.11	73	11.17	113	13.59	89	"	0.45
34	8.21	74	11.23	114	13.65	90	"	0.50
35	8.31	75	11.29	115	13.71	91	"	0.55
36	8.42	76	11.35	116	13.77	92	"	0.60
37	8.52	77	11.41	117	13.83	93	"	0.65
38	8.62	78	11.47	118	13.89	94	"	0.70
39	8.68	79	11.53	119	13.95	95	"	0.75
40	8.76	80	11.59	120	14.01			

Figure 10

FIGURE 11.-- EXAMPLE OF PROPOSED MOISTURE METER CHART

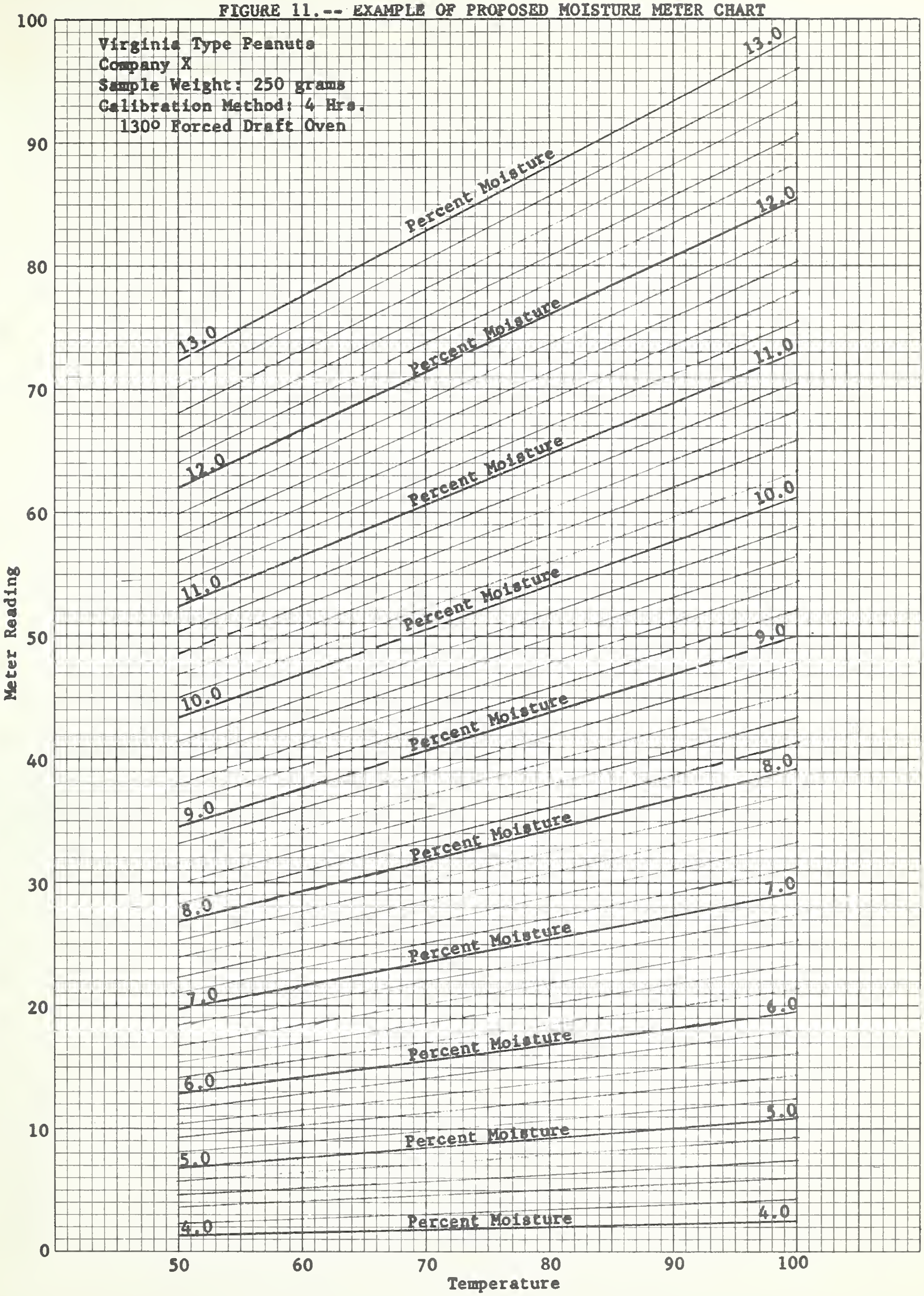

Figure 11